DOCUMENT RESUME

ED 463 944 SE 064 309

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TITLE	Action Research in Science Education. ERIC Digest.
INSTITUTION	ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, OH.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO	EDO-SE-00-01
PUB DATE	2000-10-00
NOTE	4p.
CONTRACT	ED-99-CO-0024
AVAILABLE FROM	ERIC/CSMEE, 1929 Kenny Road, Columbus, OH 43210-1080. Tel: 800-276-0462 (Toll Free); e-mail: ericse@osu.edu; Web site: http://www.ericse.org.
PUB TYPE	ERIC Publications (071) -- ERIC Digests in Full Text (073)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Action Research; Elementary Secondary Education; Science Curriculum; *Science Education; Teacher Education
IDENTIFIERS	ERIC Digests

ABSTRACT

This digest provides an introduction to action research in science education and includes examples of how action research has been used to improve teaching and learning, as well as suggested resources for those seeking to incorporate action research into their own teaching or research. Action research is defined and is examined in science education, science teacher education, the study of science learning and science curriculum development and implementation. (MM)

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ED 463 944

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By

Allan Feldman and Brenda Capobianco

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ERIC Clearinghouse for Science, Mathematics, and
Environmental Education

SE064309

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Digest

Action Research in Science Education

Allan Feldman & Brenda Capobianco

October 2000

SE 064 309 ERIC Clearinghouse for Science, Mathematics, and Environmental Education EDO-SE-00-01

This introduction to action research in science education includes examples of how action research has been used to improve teaching and learning, as well as suggested resources for those seeking to incorporate action research into their own practice of teaching or research. Many have attempted to define action research or categorize its many variants. For example, Noffke (1997) has studied personal, professional and political purposes of action research, while McKernan (1988) has focused on the ways that ideology shapes its design. Rearick and Feldman (1999) have studied other dimensions of action research, including purpose, theoretical orientation, and type of reflection used. Here we draw upon these and other reviews to define action research as *systematic inquiry by practitioners to improve teaching and learning*. Our definition assumes that the products of the inquiry are made public, adding to the knowledge bases of teaching and learning, and open to critique by peers.

Action research in science education

Action research has been utilized in three domains of science education: teacher education and professional development; research on science learning; and curriculum development and implementation. In all cases teachers are in the role of researcher, either studying their own methods of instruction and assessment; examining the cognitive processes of learning; or participating in the process of curriculum research and development.

Action research in science teacher education

Action research has been used in both preservice and inservice science teacher education, and as a way for teachers to collaborate with one another to improve practice. Hewson and colleagues (1999) use action research to help prospective teachers become reflective about what it means to teach for conceptual change. Prospective teachers designed, conducted, and presented research projects, used reflective journals as research notebooks, and participated in seminars. The process was found to help participants focus more on student conceptions and explanations, important aspects of teaching for conceptual change.

In a Science Inquiry Group (van Zee,1998). beginning and experienced teachers meet monthly to share experiences and insights about science teaching. Teachers present their findings through research festivals, Web pages, presentations at local and national conferences, and submission of case studies for publication in practitioner-based journals.

Science FEAT was a three-year teacher enhancement project (Spiegel, 1995) funded by the National Science Foundation (NSF) in which middle school science teachers studied their own teaching. University faculty members provided a course on research methods and guided teachers through individualized action research studies. The teachers met regularly in groups to discuss the progress of their research, and in the third year they presented their research in a colloquium. The research projects have been published (Spiegel, 1995) and serve as examples of how action research can be a viable, effective method of change for classroom teachers. This and other professional development programs for inservice science teachers have resulted in increased teacher knowledge and improved instructional practice (Feldman, 1996; Madsen & Gallagher, 1992), as well as more inquiry-based, problem-based learning, and constructivist science teaching (Staten, 1998).

Action research and the study of science learning

The Project for Enhancing Effective Learning (PEEL) was an action research program aimed at improving the teaching and learning of science by encouraging teachers to inquire into how their students learn (Baird & Mitchell, 1987). Teachers designed action plans that incorporated the use of innovative pedagogy in targeted classes. With support from school administrators, the teachers met as a group throughout the school year to share the progress of their research. Through reflection on their own practice in collaboration with other teachers and university researchers, the teacher researchers came to new understandings of how students learned science.

Solomon and colleagues (Solomon, Duveen, & Scot, 1992) used action research as a means of collaborating with middle school science teachers to gather data about classroom learning. The research focused on the effects of incorporating historical studies into the science curriculum on students' understanding of the nature of science and their learning of scientific concepts. Five classrooms located in three different schools were involved, and in each classroom a university researcher worked alongside a teacher on a regular basis both to observe and to assist the teachers in improving practice.

Minstrell has for more than 20 years researched in his classroom how students learn physics. By paying close attention to his students and his own teaching through the use of audiotape, videotape, and interviews, he has uncovered common misconceptions and devised methods for helping students develop deep conceptual understanding of physics concepts (Feldman & Minstrell, 2000; Minstrell, 1992). Minstrell's efforts demonstrate how a classroom teacher who is part of a community of researchers can add substantially to the knowledge base on science learning.

Action research for science curriculum development and implementation

Scope, Sequence and Coordination (SS&C) was an NSTA project aimed at transforming the ways science is taught by making instruction more student-centered and inquiry based, and by changing the curriculum sequence so that all students study all domains of science each year.

SE 064 309

During two years of the project in California, teachers engaged in action research on the local development of SS&C curriculum and the struggle to implement it in their schools (Feldman, Mason, & Goldberg, 1992; 1993; Feldman, 1995).

The transformation of science curriculum through a focus on issues of science, technology and society (STS) was the goal of several collaborative action research groups facilitated by Hodson and others (Pedretti & Hodson, 1995; Hodson & Bencze, 1998). Action research assisted participating teachers in knowing how to learn about educational issues, how to formulate their own views on curriculum, and how to critique and develop their own educational practice.

Teachers of writing and other literacy skills have been actively engaged in action research through local and National Writing Projects (Smith, 1996) and other efforts (e.g., Cochran-Smith & Lytle, 1993; Hollingsworth, 1994). Saul and Reardon (1996) directed an action research project in which elementary school teachers studied ways to integrate the teaching of reading and writing with science.

Resources for action research

Resources for those who want to use action research in science education include "how-to-do" books (Altrichter, Posch, & Somekh, 1993; Calhoun, 1994; Mills, 2000; Sagor, 1992), a chapter in the *Handbook of Research Design in Mathematics and Science Education* (Feldman & Minstrell, 2000), and published examples of science teachers' action research (e.g., Feldman et al., 1992; 1993; Minstrell, 1992; Saul & Reardon, 1996; Saurino, 1994; Spiegel, 1995)

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This digest was funded by the Office of Educational Research and Improvement, U.S. Department of Education, under contract no. ED-99-CO-0024. Opinions expressed in this digest do not necessarily reflect the positions or policies of OERI or the U.S Department of Education.

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